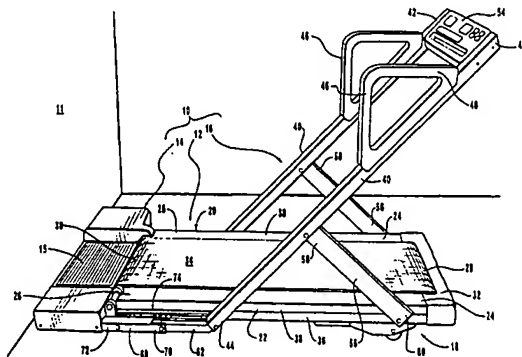




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(54) Title: **FOLD-OUT TREADMILL**

## (57) Abstract

A foldable treadmill (10) includes a deck (12) having a rear end (30) that is hingedly attached to a stationary base (14). The deck (12) can be selectively rotated between an operational position, wherein the deck (12) is substantially level, and a storage position, wherein the deck (12) is lifted so that the deck is substantially upright. The treadmill (10) also includes a handrail (16) that is movably attached to the deck (12) and which has a first end attached to the base, and an opposing second end projecting above the front end of the deck when the deck is in the operational position. The handrail (16) is configured to automatically collapse into substantial alignment with the deck when the deck is rotated into the storage position. The deck (12) and the handrail (16) are configured such that the treadmill (10) can be selectively stored against a wall, and the deck selectively rotated from the storage position to the operational position causing the handrail to also move without either the deck or handrail contacting the wall.

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**FOLD-OUT TREADMILL****BACKGROUND OF THE INVENTION**

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**1. The Field of the Invention**

The present invention relates to treadmills, and in particular to foldable treadmills.

**2. The Relevant Technology**

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Treadmills are popular exercise machines that enable a user to engage in a running or walking movement while maintaining a relatively stationary position. A conventional treadmill includes two major sections: a base and a handrail. The base includes a frame having rollers mounted on opposing ends thereof. A continuous belt extends around and between the two rollers so as to be fashioned into a flat, continuous loop. In one design, an electrical motor is connected to the front roller. When the motor is turned on, the roller spins which imparts rotational movement to the belt. In an alternative design, no motor is provided. The continuous belt is rotated by the user standing on the belt and walking or running thereon. Friction between the user and the belt cause the belt to rotate in a continuous loop around the rollers.

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The handrail acts as a support or stabilizer for the user. Conventional handrails project from the frame toward and across the front of the treadmill. Some alternative treadmills include moveable arms attached to the handrail. The movable arms enable the user to exercise their arms while running or walking on the treadmill.

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A control console can also be mounted on the handrail. The control console is used to control the operation of the treadmill and to display related information such as elapsed time, speed, pulse, or calories burned. Controls for treadmill speed, inclination, or exercise program may also be part of the control console.

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To use the treadmill, a user steps onto the continuous belt facing the front of the treadmill. The electric motor is then turned on causing the top surface of the belt to rotate from the front of the base to the rear of the base. To maintain a stationary position on the treadmill, the user must then walk or run at a speed corresponding to the speed of the belt. If desired, the user can grasp the handrail for support. When the user is done exercising, he or she simply turns the treadmill off and steps off the continuous belt.

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Early treadmills tended to be bulky due to large motors and oversized parts. Such treadmills were difficult to move around and took up relatively large amounts of space. Accordingly, these early treadmill were almost exclusively found in spas and gyms having large amounts of floor space.

As engineering improved, the size and weight of treadmills decreased. Nevertheless, the size of treadmills was limited by the length and width of the base which had to be large enough for a user to safely walk or run thereon. Due to this minimum size limitation, treadmills were significantly precluded from home or apartment use which did not have available space to house a treadmill.

In an attempt to remedy this problem, foldable treadmills were developed. Foldable treadmills include a base having rollers and a continuous belt as previously described. The front of the base, however, is hingedly attached to a stationary stand. Upstanding from the stationary stand is a handrail. The base can be selectively moved between an operation and storage position. In the operation position, the base is substantially flat. The user stands on the base facing the stationary stand and walks or runs thereon as discussed above. When use is completed, the base can be selectively moved to a storage position by lifting up the rear end of the base. The base is lifted to a substantially upright position with the front end of the base still rotatably connected to the stationary stand. By folding up the base, the treadmill takes up substantially less floor space making the treadmill more accessible for use in homes and apartments.

While foldable treadmills take up less space, they still have other drawbacks. For example, to minimize obstruction by the treadmill, it is desirable for the treadmill to be folded up against a wall when not in use. The stationary stand must be positioned proximate to the wall to enable the base to fold out. With the treadmill positioned so that the stationary stand is closest to the wall a user is forced to face into the wall during use of the treadmill. The user typically prefers to look into the room, such as toward a television or other people, during use.

To enable a user to face into a room during use of a conventional foldable treadmill, the user must first rotate the stationary stand away from the wall, and then move the treadmill sufficiently far away from the wall so that the base does not hit the wall when the base is lowered into the operational position. When use is completed, the user must fold up the treadmill and move it back to the wall for storage. This required moving of the treadmill for each use is time consuming, annoying, and awkward. As a result, the frequency of use of the treadmill is decreased, thereby partially defeating the purpose of the treadmill.

#### **BRIEF SUMMARY OF THE INVENTION**

In accordance with the invention as embodied and broadly described herein, a foldable treadmill is provided. The treadmill comprises a deck having a front end and an opposing rear end. A continuous belt is mounted on the deck and selectively rotates

thereon. Specifically, the top surface of the continuous belt rotates from the front end toward the rear end of the deck.

The rear end of the deck is hingedly attached to a stationary base. The deck can be selectively rotated between an operational position, where the deck is substantially level or otherwise positioned for operation by a person positioned thereon, and a storage position, where the front end of the deck is lifted so that the deck is substantially upright.

The treadmill also includes a collapsible handrail attached to the deck. The handrail has a first end attached to the base and an opposing second end projecting above the front end of the deck when the deck is in the operational position. The handrail is configured to automatically collapse into a compact storage configuration when the deck is rotated into the storage position. A control panel, connected to the second end of the handrail, provides the user interface for controlling and monitoring the operation of the treadmill.

The deck and the handrail are configured such that the treadmill can selectively be stored against a wall and the deck selectively rotated from the storage position to the operational position causing the handrail to also move without either the deck or handrail contacting the wall. The deck selectively rotates into an operational position in which the handrail extends toward the front of the deck, thereby allowing the user to face away from the wall.

The configuration of the inventive treadmill enables the base to be positioned against a wall so that the deck can be selectively folded into the room. In contrast to conventional foldable treadmills, however, the front end of the inventive treadmill folds into the room so that the user faces into the room during operation of the treadmill. As a result, the user can operate the treadmill while facing into the room without having to move the entire treadmill. Likewise, when use is completed, the user simply folds up the deck so that the treadmill is stored against the wall. Furthermore, the deck can be rotated between the storage position and the operational position with having to move the base of the treadmill relative to the wall.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

In order that the manner in which the above-recited and other advantages and objects of the invention are obtained, a more particular description of the invention briefly described above will be rendered by reference to a specific embodiment thereof which is illustrated in the appended drawings. Understanding that these drawings depict only a typical embodiment of the invention and are not, therefore, to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 is a perspective view of one embodiment of the fold-out treadmill in an operational position;

Figure 2A is an enlarged partial, cutaway perspective view of the fold-out treadmill shown in Figure 1;

5        Figure 2B is a perspective view of the structure shown in Figure 2A collapsed in to a storage position;

Figure 3 is a perspective view of the fold-out treadmill shown in Figure 1 folded into a storage position;

10        Figure 4 is a partial cross-sectional, elevation side view of the fold-out treadmill shown in Figure 1 in the operational position as well as the gradual changes in position that are shown in phantom as the treadmill moves from the operational position to the storage position; and

Figure 5 is a partial cross-sectional, elevation side view of the treadmill shown in Figure 3.

15        **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

The present invention relates to treadmills that are selectively foldable and enable a user to face into a room while exercising on the treadmill that is positioned substantially against a wall. Depicted in Figure 1 is one embodiment of a treadmill incorporating the features of the present invention. Treadmill 10 includes a deck 12 and a handrail 16. 20        Deck 12 is moveable between an operational position, where deck 12 is substantially flat or otherwise positioned for operation by a person positioned thereon, and a storage position in which deck 12 is substantially upright. Handrail 16 projects above deck 12 when deck 12 is in the operational position and automatically collapses into substantial alignment with deck 12 when deck 12 is rotated into the storage position.

25        More specifically, fold-out treadmill 10 comprises a base 14, deck 12, and handrail 16. Deck 12 has a back end 30 and a front end 28. Back end 30 of deck 12 is hingedly mounted to base 14. Together, deck 12 and base 14 form the support structure of treadmill 10. One embodiment of treadmill 10 is illustrated in Figure 1 with deck 12 in an operational position. In the operational position, deck 12 extends outwardly from 30        base 14 and is substantially level or somewhat inclined depending on the user's preference. Deck 12 also has a storage position in which deck 12 is substantially upright as shown in Figure 3. Deck 12 can be selectively rotated between the operational position and the storage position.

35        Referring to Figure 1, deck 12 comprises a frame structure 18 that includes a left frame member 20 and a right frame member 22. Left and right frame members 20 and 22 are defined when deck 12 is in the operational position and the user is facing front

end 28 of deck 12. As shown in Figure 1, left frame member 20 and right frame member 22 are generally aligned. Left frame member 20 and right frame member 22 each have a forward end 24 and a back end 26.

5 In the embodiment illustrated in Figure 1, deck 12 also comprises a front member 32. Front end 28 of deck 12 is defined as the forward-most end of deck 12 when deck 12 is in the operational position. A user faces front end 28 of deck 12 when using treadmill 10. Conversely, back end 30 of deck 12 is defined as the rear-most end of deck 12 proximate to base 14. Back end 30 of deck 12 is rotatably connected to base 14.

10 Front member 32 is attached to forward end 24 of both left frame member 20 and right frame member 22 at front end 28 of deck 12. Left frame member 20, right frame member 22, and front member 32 form frame structure 18 of deck 12. Left frame member 20 and right frame member 22 are in a longitudinal, spaced apart relationship while front member 32 is a cross member that extends laterally between forward end 24 of left frame member 20 and forward end 24 of right frame member 22.

15 Deck 12 has a continuous belt 34 mounted on deck 12. In particular, continuous belt 34 is positioned between left frame member 20 and right frame member 22. Continuous belt 34 is configured to receive a user thereon to perform exercises, including walking, running, jogging and other similar or related activities. Treadmill 10 can also be used for stationary exercises, such as stretching or bending, while the user is standing on continuous belt 34. The primary function, however, of treadmill 10 is for running, walking or jogging.

20 One embodiment of left frame member 20 and right frame member 22 of frame structure 18 comprises a side rail 36 and a side base 38. As illustrated in Figure 1, side base 38 is positioned over the top of side rail 36 of both left frame member 20 and right frame member 22. Left frame member 20 is not totally visible in Figure 1 but is a mirror image of right frame member 22. Side bases 38 of left frame member 20 and right frame member 22 are capable of supporting the weight of a user standing thereon. Side bases 38 are positioned on each side of continuous belt 34.

25 The position of side bases 38 of both left frame member 20 and right frame member 22 are such that a user of treadmill 10 can comfortably and easily step off of continuous belt 34 onto one or both of side bases 38. The user can also stand on side base 38 of either left frame member 20 or right frame member 22 or both until he or she is ready to step onto continuous belt 34. In addition, side bases 38 are wide enough for the user to comfortably place his or her foot thereon. It can be appreciated that other  
35 embodiments of left frame member 20 and right frame member 22 or the components thereof are equally effective in carrying out the intended function thereof.

Treadmill 10 also comprises base 14 that is movably attached to back end 30 of deck 12. One embodiment of base 14, shown in Figure 1, includes main body 15 and a pair of stabilizer members 68. Main body 15 of base 14 is positioned substantially directly behind endless belt 34 such that should the user roll backwards off of endless belt 34, he or she will land on main body 15 of base 14. Main body 15 has a low profile as will be discussed below that enables main body 15 to be slightly shorter in height than endless belt 34 when deck 12 is in the operational position. This helps to prevent the user from hitting base 14 while running or walking on treadmill 10. Base 14 is also configured to rest on a support surface with its rear end abutting, or in close proximity to, a wall.

One embodiment of treadmill 10 includes a switching mechanism on base 14 that automatically turns off motor 98 when the user is on main body 15 and, consequently, prevents a user from being trapped on main body 15 after inadvertently landing on main body 15 while treadmill 10 continuing to run.

Stabilizer members 68 have a forward end 70 and a back end 72. Back end 72 of each stabilizer member 68 is fixedly attached to main body 15 of base 14 near the periphery thereof and extends outwardly from main body 15 in a direction generally parallel with deck 12 when deck 12 is in the operational position.

In one embodiment, back end 30 of deck 12 is rotatably attached to base 14 by conventional methods. Specifically, back end 26 of both left frame member 20 and right frame member 22 is pivotally attached to base 14 and extends laterally across back end 26 of both left frame member 20 and right frame member 22. Various other embodiments of structure capable of performing the function of a means for connecting deck 12 to base 14 so as to enable deck 12 to selectively rotate between the operational position in which deck 12 is substantially level, and a storage position in which deck 12 is substantially upright, are equally effective in performing the intended function thereof.

Figure 1 also shows one embodiment of handrail 16 that is movably attached to base 14 and deck 12. One embodiment of handrail 16 is substantially U-shaped. When deck 12 is in the operational position handrail 16 is open at the rear-most portion and closed at the front-most portion. As shown in Figure 1, handrail 16 extends across deck 12 at front end 28 of deck 12 when deck 12 is in the operational position. It can be appreciated that various other configurations of handrail 16 are equally effective in performing the intended function thereof.

Handrail 16 is configured to automatically collapse into substantial alignment with deck 12 when deck 12 is in the storage position, as shown in Figure 3. Handrail 16 has a first end 48 and a second end 50. First end 48 of handrail 16 is attached to base 14, and



second end 50 of handrail 16 is projects above front end 28 of deck 12 when deck 12 is in the operational position.

Referring again to Figure 1, handrail 16 comprises a pair of uprights 40. For clarity, the right side of handrail 16 is described, keeping in mind that the left side thereof is the mirror image of the right side of handrail 16. Uprights 40 are movably attached to base 14 and frame structure 18 of deck 12. Uprights 40 have a lower end 44 movably attached to base 14 and deck 12 and an opposing upper end 42 projecting above front end 28 of deck 12 when deck 12 is in the operational position. Lower end 44 of upright 40 is movably attached to right frame member 22 of frame structure 18. The specific attachment of upright 40 to right frame member 22 will be discussed in further detail below.

Handrail 16 also includes a pair of handles 46 that are fixedly attached to uprights 40 and extend outwardly from uprights 40 toward back end 30 of deck 12. Handle 46 is attached to each upright 40 near upper end 42 thereof. The configuration of handles 46 may vary. Handles 46 must be capable of supporting the user of treadmill 10. In addition, handles 46 must be comfortable for a user to grab or hold. Handles 46 are attached to uprights 40 by conventional methods such as screws, bolts, or welds. In the embodiment illustrated in Figure 1, handles 46 are bolted to uprights 40.

Handrail 16 may comprise an optional control console 54. Console 54 may be attached to upper end 42 of the pair of uprights 40. Control console 54 provides the user interface for monitoring and controlling operation of treadmill 10 and may have operating controls such as an actuator switch to operate treadmill 10 and indicator means which may be operated by the user to determine various parameters associated with the exercise being performed. Console 54 may also include such things as a cup or glass holder so that the user may position a liquid refreshment for use during the course of performing the exercise. It can be appreciated that various embodiments of console 54 are possible and may be so simple as to include only an on/off switch. It is contemplated that console 54 may be completely replaced by a support member.

When deck 12 is in the operational position, and handrail 16 is projecting above front end 28 of deck 12, handrail 16 defines the sides of an exercise space therebetween. Handles 46 are designed and positioned such that they are near the hands of the user for easy and quick grasping should a user need handles 46 to maintain his or her balance when the user is exercising on continuous belt 34, as well as making the user feel stable and secure while using treadmill 10.

A pair of elongated supports 56 are movably attached to handrail 16 and deck 12, as shown in Figure 1. Elongated supports 56 have a first end 58 that is movably attached

to upright 40 of handrail 16 and a second end 60 that is movably attached to frame structure 18 of deck 12. As with handrail 16, the right side and left side of treadmill 10 are mirror images and for clarity, only the right side will be discussed in detail. First end 58 of elongated support 56 is pivotally attached to upright 40. Lower end 60 is pivotally attached to side rail 36 of right frame member 20. Other methods of movably attaching first end 58 to upright 40 and second end 60 to side rail 36 are equally effective in carrying out the function thereof.

In one embodiment of treadmill 10, lower end 44 of upright 40 of handrail 16 is movably attached to a leg 62. As shown in Figure 2A, leg 62 has a proximal end 64 that is movably attached to lower end 44 of upright 40 and a distal end 66 that is movably attached to forward end 70 of stabilizer member 68. In the embodiment illustrated in Figure 2A, distal end 66 of leg 62 is pivotally attached to forward end 70 of stabilizer member 68. Other methods of movably attaching distal end 66 of leg 62 to forward end 70 of stabilizer member 68 are equally effective in carrying out the intended function thereof.

An elongated slider bracket 74 is fixedly attached to the exposed outside surface 78 of both left frame member 20 and right frame member 22. Slider bracket 74 is attached to side rail 36. Slider bracket 74 is capable of receiving a wheel 76 rotatably attached to handrail 16 and allowing linear translation of lower end 44 of upright 40 of handrail 16 relative to deck 12. Wheel 76 is configured to cooperate with slider bracket 74 and is disposed therein. Wheel 76 is movably attached to the inside of upright 40 of handrail 16 proximate to deck 12 near or at the point of attachment between lower end 44 of upright 40 and proximate end 64 of leg 62. Elongated slider bracket 74 and wheel 76 illustrated in Figures 2A and 2B are one embodiment of structure capable of preforming the function of a slider means for allowing linear translation of handrail 16 relative to deck 12.

Elongated supports 56, legs 62, and slider means are one embodiment of structure capable of performing the function of a fold-out means for attaching handrail 16 to deck 12 so as to enable handrail 16 to project above deck 12 when deck 12 is in the operational position and to automatically collapse into substantial alignment with deck 12 when deck 12 is rotated into the storage position. Fold-out means enables deck 12 to be repositioned by pivotal movement from the storage position into the operational position and simultaneously handrail 16 to be repositioned by a combination of pivotal movement and linear translation. Figures 2A and 2B illustrate the pivotal movement and linear translation allowed by fold-out means when deck 12 is pivoting between the operational

position and the storage position while simultaneously handrail 16 pivots and linearly translates automatically in response to the movement by deck 12.

When treadmill 10 is being repositioned, deck 12 and handrail 16 unfold outwardly so as to allow a user on deck 12 to be facing front end 28 of deck 12 as illustrated in Figure 1. In those cases that treadmill 10 is selectively stored against a wall 11, deck 12 and handrail 16 unfold outwardly from wall 11 so that a user is both facing away from wall 11 and toward front end 28 of deck 12. It can be appreciated that various embodiments of structure capable of performing the function of such a fold-out means are equally effective in carrying out the intended function thereof.

Figure 3 illustrates deck 12 in the storage position where handrail 16 has automatically collapsed into substantial alignment with deck 12. In the storage position, deck 12 and handrail 16 are substantially upright. In this configuration, treadmill 10 is significantly more compact and occupies less floor space. When deck 12 is in the storage position, treadmill 10 is supported by base 14. Base 14 comprises body 15 and stabilizer members 68 and is configured to be freestanding. Base 14 stably supports treadmill 10 when deck 12 is in the storage position and during movement between the storage position and operational position.

While the drawing and foregoing description disclose one presently preferred embodiment, it should be appreciated that other handrail configurations may be readily adapted for use with the present invention. For example, instead of handrail 16 folding and unfolding in a single motion as deck 12 is moved between the operational and storage positions, other more simplified handrail configurations can readily be employed wherein deck 12 is rotated between the its storage and operational positions in one motion and, then in a second and separate motion, handrail 16 and control console 54 are rotated between their compact storage and their operational positions.

As illustrated in Figure 3, deck 12 may include a rigid undercover 90 secured to frame structure 18. The rigid undercover 90 may be formed of plastic-like material to create an essentially rigid underside to deck 12. Although undercover 90 is rigid, undercover 90 may be made of material thin enough to be flexible or to deflect without breaking. Without rigid undercover 90 deck 12 has exposed operating structure such as electrical components and any inclination system are exposed. Aside from an undesirable visual appearance, the exposed components can be hazardous because of having sharp edges, points and structures against which things or items may bump or snag. Similarly, there is a risk of exposing any electrical components to moisture as well as exposing the user to an electrical shock hazard if the treadmill is inadvertently not turned off. It may also be noted that undercover 90 may be formed to cover only a portion of the exposed

components or may be formed into multiple or removable sections to facilitate any needed repair.

As depicted in Figure 3, one embodiment of deck 12 includes a pair of feet 92 which are rotatably secured to each side of the frame structure 18. Specifically, feet 92 are pivotally secured to right frame member 22 and frame member 20. Other conventional methods of movably attaching feet 92 are equally effective in carrying out the intended function thereof.

Deck 12 may include a mechanism for automatically varying the inclination of deck 12 relative to the support surface. A motor connected to a rack and a pinion which is connected to feet 92 may be used to vary the inclination of deck 12. Rotatable feet 92 and a mechanism for automatically varying the inclination are one example of structure capable of performing the function of an incline means for varying the inclination of deck 12 relative to the underlying support surface. It is contemplated that various types of known inclination means may be incorporated within deck 12. Other types of inclination means are equally effective in carrying out the intended function thereof.

As illustrated in Figure 4, base 14 has a cover 100 positioned over structure such as a drive means for supplying power to deck 12 to drive continuous belt 34. Cover 100 provides a place for the user of treadmill 10 to stand prior to getting on continuous belt 34 or when stepping off of continuous belt 34 as well as for aesthetics and safety reasons to minimize the risk of materials entering the drive mechanism or otherwise interfering with the operation and mechanism.

Base 14 also comprises a forward cross-support 94 which is disposed between stabilizer members 68. Similarly, base 14 includes a rear cross-support 96 that extends between and is connected to the back-most part of body 15 of base 14. Forward and rear cross-supports 94 and 96, respectively, may be attached to body 15 of base 14 by conventional attachment methods such as by nuts and bolts, brackets, welds, or by braising.

Base 14 is sized and configured so as to provide adequate support to treadmill 10 when deck 12 is in the storage position. Base 14 also provides sufficient support while repositioning deck 12 from the operational position to the storage position when handrail 16 is automatically collapsing into substantial alignment with deck 12. Base 14 is sized to provide treadmill 10 with sufficient support so that deck 12 is stably supported in the storage position, in the operational position and during movement in between. Base 14 is also able to support handrail 16 as it moves simultaneously with deck 12.

Base 14 could be in any desired geometric shape with a predetermined length and width. The length and width are selected so that the distance between the vertical

location of the center of gravity of treadmill 10 is are such that the force necessary to tip treadmill 10 is necessarily more than that applied by an accidental bump or nudge. The distance base 14, including stabilizing members 68, extends outward away from wall 11 in the direction that deck 12 rotates when moving into the operational position, is selected such that tipping of treadmill 10 can be effected only by a user deliberately seeking to tip treadmill 10.

Similarly, the width of base 14 is selected so that the distance between the center of gravity and the perimeter of base 14 will resist accidental tipping by a bump or nudge. That is, treadmill 10 cannot be tipped sideways except by the application of a user deliberately seeking to tip treadmill 10 sideways.

As illustrated in Figures 4 and 5, treadmill 10 also comprises a motor 98 that rotates a first pulley 100 that drives a belt 102. Belt 102 drives a second pulley 104 connected to rear roller 106 about which continuous belt 34 is disposed. The forward portion of continuous belt 34 also is disposed around a front roller 108. Rear roller 106 and front roller 108 are attached laterally between left frame member 22 and right frame member 24. Motor 98, pulleys 100, 104, and belt 102 are one embodiment of structure capable of performing the function of a drive means for supplying power to deck 12 to drive continuous belt 34. Other embodiments capable of performing the function of such drive means may include a flywheel. Various embodiments of drive means are equally effective in carrying out the intended function thereof.

As can be seen in Figure 4, motor 98, pulley 100, 104, and belt 102 are positioned within base 14 to the side of main body 15. The portion of base 14 that includes motor 98, pulleys 100, 104, and belt 102 is slightly raised in height when compared to main body 15. One advantage of having main body 15 separate from the drive means is that the height of main body 15 can be reduced and is closer to support surface. This makes it easier for the user to step on and off of main body 15 of base 14. Reducing the height of base 14 also reduces the necessary height of deck 12. As a result, the height of the exercise surface formed by endless belt 34 is reduced. The weight of the drive means acts as a counterbalance to stabilize treadmill 10 when deck 12 is being reoriented from the operational position shown in Figure 1 to the storage position illustrated in Figure 3.

An alternate embodiment of treadmill 10 includes deck 12 with drive means comprising a flywheel. Flywheel is connected to the continuous belt 34 and receives energy from the user operating the continuous belt 34 of deck 12. Flywheel also delivers energy to that continuous belt 34 as the user performs walking, running, or jogging exercises when the user is suspended and not in contact with continuous belt 34. In those embodiments of treadmill 10 that utilize a flywheel as a drive means rather than an

electric motor, the operator may begin using treadmill 10 once deck 12 has been moved to the operational position.

Deck 12 has a longitudinal length which is selected to facilitate the performance of walking, jogging, or running exercises desired. The length may vary for treadmills configured for walking and treadmills configured for jogging and running. In addition, the length of the continuous belt 34 will vary correspondingly.

For some users, the amount of lifting force necessary to move deck 12 from the operational position to the storage position with handrail 16 automatically collapsing into substantial alignment with deck 12 may be large enough that rotating deck 12 is difficult. Figure 3 illustrates one embodiment of treadmill 10 that incorporates a pneumatic cylinder 110. Pneumatic cylinder 110 is rotatably attached at one end to deck 12 and the opposite end thereof is attached to stabilizing member 68 of base 14. The embodiment of deck 12 illustrated in Figures 3 and 5 have pneumatic cylinder 110 attached to right frame member 22 of frame structure 18 and associated right side of base 14. Pneumatic cylinder 110 could instead be attached to the left frame member 20 of deck 12 and left side of base 14. Pneumatic cylinder 110 is one example of structure capable of performing the function of lift assistance means for applying a force urging deck 12 to move from the operational position to the storage position. Other embodiments of structure capable of performing the function of a lift assistance means are equally effective in carrying out the intended function thereof.

It is also contemplated that handrail 16 may comprise moveable arms rotatably attached to the inside surface of uprights 40. For example, in one embodiment of handrail 16 moveable arms are pivotally attached to uprights 40 with a hand operated knob to tighten and secure moveable arms and to increase or decrease the resistance of the moveable arms to rotation. The moveable arms have a gripping portion configured for grasping by a user.

To use fold-out treadmill 10, a user rotates deck 12 from the storage position shown in Figure 3 to the operational position as shown in Figure 1. Figure 4 shows the various interim positions as deck 12 moves from the operational position to the storage position. In the operational position, base 14 and deck 12 define a "footprint" of treadmill 10. It is intended that the "footprint" of treadmill 10 be regarded as the perimeter of the geometric figure of base 14 and deck 12 projected on to the support surface when tread base 12 is in the operational position. When deck 12 is moved from the storage position to the operational position, handrail 16 automatically moves into a position projecting above the front end 28 of deck 12. As deck 12 is moved between the operational position and the storage position, handrail 16 also moves. At all times during

the movement of deck 12 between the operational position and storage position, both deck 12 and handrail 16 remain at all times within the "footprint" of treadmill 10. This enables treadmill 10 to be placed against a wall and remain there while deck 12 is moved between the operational and storage positions without either deck 12 or handrail 16 contacting the wall.

With deck 12 in the operational position, the user stands on continuous belt 34 and walks, jogs, or runs to perform exercises. If the user desires to vary the inclination, the user may, depending on the embodiment of treadmill 10, operate a switch on console 54 to electrically operate the automatic incline means or may manually adjust the incline means shown in Figure 3 by rotating feet 92. The user may thereafter operate console 54 to energize the motor. In order to operate treadmill 10 utilizing an electric drive means, the user must provide energy to the system by inserting the plug into a conveniently available wall outlet.

Once the user is done exercising on treadmill 10, deck 12 is repositioned into the storage position by lifting front end 28 of deck 12, which causes handrail 16 to automatically collapse into substantial alignment with deck 12 when deck 12 is rotated into the storage position. Specifically, lifting front 28 of deck 12 causes elongated support 56 to rotate downward about the pivotal connection of lower end 60 toward deck 12. The rotational movement of elongated support 56 causes lower end 44 of upright 40 of handrail 16 that is attached to wheel 76 disposed in slider bracket 74 to translate linearly relative to deck 12. The linear translation of upright 40 causes distal end 66 of leg 62 to rotate, while proximal end 64 of leg 62 that is attached to lower end 44 of upright 40 rotates. The rotational movement of the various structural parts as well as the linear translation of handrail 16 relative to deck 12 happens substantially simultaneously while deck 12 is being lifted at front end 28 thereof. The rotational movement and the linear translation of handrail 16 automatically occurs every time deck 12 is repositioning between the operational position and the storage position. In addition, the rotational movement and the linear translation of handrail 16 keeps handrail 16 within the "footprint" of treadmill 10.

Although not shown in the figures, it is contemplated that treadmill 10 may also include a latching means for retaining deck 10 in the storage position with handrail 16 collapsed into substantial alignment with deck 12. Those skilled in the art will recognize that various forms and shapes of latching mechanism may be used to facilitate the automatic latching arrangement.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be

considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.



What is claimed is:

1. A treadmill for storage against a wall comprising:

(a) a base having a rear end and an opposing front end, said base configured to rest upon a support surface with its rear end abutting or in close proximity to said wall;

(b) a deck having a rear end, an opposing front end and a continuous belt rotatably mounted thereon, the rear end of said deck being movably attached to said base so as to enable said deck to selectively rotate between an operational position, in which said deck is positioned for operation by a user positioned thereon, and a storage position, in which said deck is substantially upright, said deck having a continuous belt rotatably mounted thereon; and

(c) a handrail movably attached between said base and said deck, said handrail being configured to fold into a compact storage configuration when said deck is moved from said operational position to said storage position and to unfold when said deck is moved from said storage position to said operational position such that said handrail extends above said front end of said deck when said deck is in said operational position thereby enabling a user to face away from the wall while exercising thereon, and wherein said deck can be moved between said operational position and said storage position without moving said base relative to said wall.

2. A treadmill as recited in Claim 1, further comprising a fold-out means for attaching said handrail to said deck so as to enable said handrail to project above said deck when said deck is in said operational position and to automatically collapse into said compact storage configuration when said deck is rotated into said storage position, said fold-out means being configured such that said handrail is repositioned by a combination of pivotal movement and linear translation as said deck is selectively repositioned by pivotal movement from said storage position into said operational position.

3. A treadmill as recited in Claim 1, wherein said base and said deck define a footprint when said deck is in said operational position and wherein said handrail and said deck remain entirely within said footprint as said deck is moved between said operational position and said storage position.

4. A treadmill for storage against a wall comprising:

(a) a base;

(b) a deck having a first end and an opposing second end, said second end being hingedly mounted to said base so as to enable said deck to selectively rotate between an operational position, in which said deck folds away from said

wall and into a substantially level position, and a storage position, in which said deck folds up toward the wall and into a substantially upright position;

(c) a continuous belt rotatably mounted on said deck, said belt having a top surface rotatable from said first end of said deck toward said second end of said deck; and

(d) a handrail having a first end and an opposing second end, the second end of said handrail being movably attached between said base and said deck, said handrail being configured to fold into a compact storage configuration when said deck is moved from said operational position to said storage position and to unfold when said deck is moved from said storage position to said operational position such that said the first end of said handrail extends above the first end of said deck when said deck is in said operational position thereby enabling a user to face away from the wall while exercising thereon, and wherein said deck can be moved between said operational position and said storage position without moving said base relative to said wall.

5. A treadmill as recited in Claim 4, wherein said treadmill further comprises a control panel connected to the first end of said handrail so as to provide a user interface relating to operation of said treadmill.

6. A treadmill as recited in Claim 5, further comprising fold-out means for attaching said handrail to said deck so as to enable said handrail to project above the first end of said deck when said deck is in said operational position and to automatically collapse into a compact storage configuration when said deck is rotated into said storage position.

7. A treadmill as recited in Claim 6, wherein said fold-out means comprises:

(a) a leg having a proximal end rotatably attached to the second end of said handrail and a distal end rotatably attached to said base, said proximal end of said leg and the second end of said handrail being movably attached to said deck, thereby allowing said handrail to automatically collapse into a compact storage configuration when said deck is rotated from said operational position into said storage position; and

(b) slider means, attached to said deck, for allowing linear translation of the second end of said handrail relative to said deck, when said deck is rotated into said storage position.

8. A treadmill as recited in Claim 7, wherein said slider means comprises:

(a) an elongated bracket attached to said deck; and

(b) a wheel, rotatably attached to the second end of said handrail, said wheel being rotatably disposed in said elongated bracket allowing the second end of said handrail to linearly translate relative to said deck so as to make said handrail automatically collapse into a compact storage configuration when said deck is rotated into said storage position.

9. A treadmill as recited in Claim 4, wherein said deck comprises a first side and a second side having a spaced apart relationship, said deck also comprising a first roller and a second roller extending laterally between said first side and said second side of said deck at opposite ends thereof.

10. A treadmill as recited in Claim 9, further comprising drive means for supplying power to said deck to rotate said continuous belt.

11. A treadmill as recited in Claim 10, wherein said second roller is operably coupled to said drive means.

12. A treadmill as recited in Claim 4, further comprising incline means attached to said deck for varying the inclination of said deck relative to a support surface while said deck is in said operational position.

13. A treadmill as recited in Claim 4, further comprising lift assistance means for applying a force urging said deck to move from said operational position to said storage position.

14. A treadmill as recited in Claim 13, wherein said lift assistance means comprises a pneumatic cylinder rotatably attached at one end to said deck and the opposite end thereof being rotatably attached to said base.

15. A treadmill comprising:

(a) a support structure comprising  
(i) a base having a rear end and an opposing front end, said base configured to rest upon a support surface with its rear end abutting or in close proximity to said wall;

(ii) a deck having a front end, a rear end, a left side and a right side, said deck having an endless belt positioned between said left side and said right side, the rear end of said deck being hinged mounted to said base so as to enable said deck to selectively rotate between an operational position, in which said deck is positioned for operation by a user positioned thereon, and a storage position, in which said deck is substantially upright;

(b) a control panel for providing a user interface relating to operation of said treadmill; and

(c) means for coupling said control panel to said support structure, wherein said control panel and said coupling means fold into a compact storage configuration when said deck is moved from said operational position to said storage position and unfold when said deck is moved from said storage position to said operational position such that said control panel extends above said front end of said deck and is visible to a user positioned on said deck and facing away from said wall when said deck is in said operational position, thereby enabling the user to face away from the wall while exercising thereon, and wherein said deck can be moved between said operational position and said storage position without moving said base relative to said wall.

16. A treadmill as recited in Claim 15, wherein said coupling means further comprises:

- (a) a handrail having a front end and an opposing rear end, wherein the front end of said handrail is connected to and supports said control panel; and
- (b) fold-out means for attaching said handrail to said deck so as to enable said handrail to project above the front end of said deck when said deck is in said operational position and to automatically collapse into a compact storage configuration when said deck is rotated into said storage position.

17. A treadmill as recited in Claim 16, wherein said fold-out means comprises:

- (a) an elongated support having an upper end rotatably attached to said handrail and a lower end rotatably attached to said deck; and
- (b) a leg having a proximal end rotatably attached to the rear end of said handrail and a distal end rotatably attached to said base, said proximal end of said leg and the rear end of said handrail being movably attached to said deck to allow said handrail to linearly translate relative to said deck while automatically collapsing into a compact storage configuration when said deck is rotated from said operational position into said storage position; and
- (c) slider means, attached to the rear end of said handrail, for allowing linear translation of said handrail relative to said deck.

18. A treadmill as recited in Claim 15, wherein said continuous belt extends between said rear end and said front end of said deck.

19. A treadmill comprising:

- (a) a support structure comprising

- (i) a base having a rear end and an opposing front end, said base configured to rest upon a support surface with its rear end abutting or in close proximity to said wall;
- (ii) a deck having a front end, a rear end, a left side and a right side, said deck having an endless belt positioned between said left side and said right side, the rear end of said deck being hingedly mounted to said base so as to enable said deck to selectively rotate between an operational position, in which said deck is positioned for operation by a user positioned thereon, and a storage position, in which said deck is substantially upright;
- (b) a handrail having a rear end and a front end;
- (c) fold-out means for attaching the rear end of said handrail to said support structure so as to enable the front end of said handrail to project above the front end of said deck when said deck is in said operational position and to automatically collapse into a compact storage configuration when said deck is rotated into said storage position; and
- (d) a control panel connected to the second end of said handrail providing a user interface for operation of said treadmill,
- wherein said deck can be moved between said operational position and said storage position without moving said base relative to said wall.
20. A treadmill as recited in Claim 19, wherein said fold-out means comprises:
- (a) a leg having a proximal end rotatably attached to the rear end of said handrail and a distal end rotatably attached to said base, said proximal end of said leg and the rear end of said handrail being movably attached to said deck to allow said handrail to automatically collapse into a compact storage configuration when said deck is rotated from said operational position into said storage position by a combination of rotational movement and linear translation relative to said deck; and
- (b) slider means, attached to the rear end of said handrail, for allowing linear translation of said handrail relative to said deck.
21. A treadmill as recited in Claim 19, wherein said base is capable of stably supporting the treadmill when said deck is in either said operational position or said storage position and when said deck is being repositioned therebetween.
22. A treadmill as recited in Claim 21, wherein said base comprises a body and a stabilizer member attached thereto.

23. A treadmill as recited in Claim 19, further comprising a pneumatic cylinder rotatably attached at one end thereof to said deck and at the opposite end thereof being rotatably attached to said base.

24. A treadmill as recited in Claim 19, wherein said handrail comprises:

- 5 (a) a pair of uprights movably connected to said deck, said pair of uprights being configured to project above said deck when said deck is in said operational position and to automatically collapse into substantial alignment with said deck when said deck is rotated into said storage position; and
- 10 (b) a pair of handles attached to said uprights.

**AMENDED CLAIMS**

[received by the International Bureau on 16 March 1999 (16.03.99);  
original claims 1-24 replaced by amended claims 1-24 (6 pages)]

5 (a) a base having a rear end and an opposing front end, said base configured to rest upon a support surface with its rear end abutting or in close proximity to the wall;

(b) a deck having a rear end, an opposing front end and a continuous belt rotatably mounted thereon, the rear end of said deck being movably attached to said base so as to enable said deck to selectively rotate between an operational position, in which said deck is positioned for operation by a user positioned thereon, and a storage position, 10 in which said deck is substantially upright, said deck having a continuous belt rotatably mounted thereon; and

(c) a handrail movably attached between said base and said deck, said handrail being configured to fold into a compact storage configuration when said deck is moved from said operational position to said storage position such that said handrail 15 does not extend beyond said rear end of said base and to unfold when said deck is moved from said storage position to said operational position such that said handrail extends above said front end of said deck when said deck is in said operational position thereby enabling a user to face away from the wall while exercising thereon, said handrail further being configured such that while said deck is being moved between said operational 20 position and said storage position said handrail does not extend beyond said rear end of said base thereby allowing said deck to be moved between said operational position and said storage position without a user having to reposition said base relative to the wall.

2. A treadmill as recited in Claim 1, further comprising a fold-out means for attaching said handrail to said deck so as to enable said handrail to project above said 25 deck when said deck is in said operational position and to automatically collapse into said compact storage configuration when said deck is rotated into said storage position, said fold-out means being configured such that said handrail is repositioned by a combination of pivotal movement and linear translation as said deck is selectively repositioned by pivotal movement from said storage position into said operational position.

30 3. A treadmill as recited in Claim 1, wherein said base and said deck define a footprint when said deck is in said operational position and wherein said handrail and said deck remain entirely within said footprint as said deck is moved between said operational position and said storage position.

4. A treadmill for storage against a wall comprising:

35 (a) a base;

(b) a deck having a first end and an opposing second end, said second end being hingedly mounted to said base so as to enable said deck to selectively rotate between an operational position, in which said deck folds away from the wall and into a substantially level position, and a storage position, in which said deck folds up toward the wall and into a substantially upright position;

(c) a continuous belt rotatably mounted on said deck, said belt having a top surface rotatable from said first end of said deck toward said second end of said deck; and

(d) a handrail having a first end and an opposing second end, the second end of said handrail being movably attached between said base and said deck, said handrail being configured to fold into a compact storage configuration when said deck is moved from said operational position to said storage position such that said handrail does not extend beyond said rear end of said base and to unfold when said deck is moved from said storage position to said operational position such that said the first end of said handrail extends above the first end of said deck when said deck is in said operational position thereby enabling a user to face away from the wall while exercising thereon, said handrail further being configured such that while said deck is being moved between said operational position and said storage position said handrail does not extend beyond said rear end of said base thereby allowing said deck to be moved between said operational position and said storage position without a user having to reposition said base relative to the wall.

5. A treadmill as recited in Claim 4, wherein said treadmill further comprises a control panel connected to the first end of said handrail so as to provide a user interface relating to operation of said treadmill.

6. A treadmill as recited in Claim 5, further comprising fold-out means for attaching said handrail to said deck so as to enable said handrail to project above the first end of said deck when said deck is in said operational position and to automatically collapse into a compact storage configuration when said deck is rotated into said storage position.

7. A treadmill as recited in Claim 6, wherein said fold-out means comprises:

(a) leg having a proximal end rotatably attached to the second end of said handrail and a distal end rotatably attached to said base, said proximal end of said leg and the second end of said handrail being movably attached to said deck, thereby allowing said handrail to automatically collapse into a compact storage configuration when said deck is rotated from said operational position into said storage position; and



(b) slider means, attached to said deck, for allowing linear translation of the second end of said handrail relative to said deck, when said deck is rotated into said storage position.

8. A treadmill as recited in Claim 7, wherein said slider means comprises:

(a) an elongated bracket attached to said deck; and

(b) a wheel, rotatably attached to the second end of said handrail, said wheel being rotatably disposed in said elongated bracket allowing the second end of said handrail to linearly translate relative to said deck so as to make said handrail automatically collapse into a compact storage configuration when said deck is rotated into said storage position.

9. A treadmill as recited in Claim 4, wherein said deck comprises a first side and a second side having a spaced apart relationship, said deck also comprising a first roller and a second roller extending laterally between said first side and said second side of said deck at opposite ends thereof.

10. A treadmill as recited in Claim 9, further comprising drive means for supplying power to said deck to rotate said continuous belt.

11. A treadmill as recited in Claim 10, wherein said second roller is operably coupled to said drive means.

12. A treadmill as recited in Claim 4, further comprising incline means attached to said deck for varying the inclination of said deck relative to a support surface while said deck is in said operational position.

13. A treadmill as recited in Claim 4, further comprising lift assistance means for applying a force urging said deck to move from said operational position to said storage position.

14. A treadmill as recited in Claim 13, wherein said lift assistance means comprises a pneumatic cylinder rotatably attached at one end to said deck and the opposite end thereof being rotatably attached to said base.

15. A treadmill comprising:

(a) a support structure comprising

(i) a base having a rear end and an opposing front end, said base configured to rest upon a support surface with its rear end abutting or in close proximity to a wall;

(ii) a deck having a front end, a rear end, a left side and a right side, said deck having an endless belt positioned between said left side and said right side, the rear end of said deck being hingedly mounted to said base so as to enable said deck to selectively rotate between an operational position, in which said deck

is positioned for operation by a user positioned thereon, and a storage position, in which said deck is substantially upright;

(b) a control panel for providing a user interface relating to operation of said treadmill; and

5 (c) means for coupling said control panel to said support structure, wherein said control panel and said coupling means fold into a compact storage configuration when said deck is moved from said operational position to said storage position such that neither said coupling means nor said control panel extends beyond said rear end of said base and unfold when said deck is moved from said storage position to said operational  
10 position such that said control panel extends above said front end of said deck and is visible to a user positioned on said deck and facing away from the wall when said deck is in said operational position, thereby enabling the user to face away from the wall while exercising thereon, said coupling means further being configured such that when said deck is being moved between said operational position and said storage position neither  
15 said coupling means nor said control panel extends beyond said rear end of said base thereby allowing said deck to be moved between said operational position and said storage position without a user having to reposition said base relative to the wall.

16. A treadmill as recited in Claim 15, wherein said coupling means further comprises:

20 (a) a handrail having a front end and an opposing rear end, wherein the front end of said handrail is connected to and supports said control panel; and

(b) fold-out means for attaching said handrail to said deck so as to enable said handrail to project above the front end of said deck when said deck is in said operational position and to automatically collapse into a compact storage configuration when said  
25 deck is rotated into said storage position.

17. A treadmill as recited in Claim 16, wherein said fold-out means comprises:

(a) an elongated support having an upper end rotatably attached to said handrail and a lower end rotatably attached to said deck; and

30 (b) a leg having a proximal end rotatably attached to the rear end of said handrail and a distal end rotatably attached to said base, said proximal end of said leg and the rear end of said handrail being movably attached to said deck to allow said handrail to linearly translate relative to said deck while automatically collapsing into a compact storage configuration when said deck is rotated from said operational position into said  
35 storage position; and

(c) slider means, attached to the rear end of said handrail, for allowing linear translation of said handrail relative to said deck.

18. A treadmill as recited in Claim 15, wherein said continuous belt extends between said rear end and said front end of said deck.

5 19. A treadmill comprising:

(a) a support structure comprising

(i) a base having a rear end and an opposing front end, said base configured to rest upon a support surface with its rear end abutting or in close proximity to a wall;

10 (ii) a deck having a front end, a rear end, a left side and a right side, said deck having an endless belt positioned between said left side and said right side, the rear end of said deck being hingedly mounted to said base so as to enable said deck to selectively rotate between an operational position, in which said deck is positioned for operation by a user positioned thereon, and a storage position, in which said deck is substantially upright;

15 (b) a handrail having a rear end and a front end;

(c) fold-out means for attaching the rear end of said handrail to said support structure so as to enable the front end of said handrail to project above the front end of said deck when said deck is in said operational position and to automatically collapse into a compact storage configuration such that said handrail does not extend beyond said rear end of said base when said deck is rotated into said storage position; and

20 (d) a control panel connected to the second end of said handrail providing a user interface for operation of said treadmill,

wherein said handrail further being configured such that when said deck is being moved between said operational position and said storage position said handrail does not extend beyond said rear end of said base thereby allowing said deck to be moved between said operational position and said storage position without a user having to reposition said base relative to the wall.

25 20. A treadmill as recited in Claim 19, wherein said fold-out means comprises:

30 (a) a leg having a proximal end rotatably attached to the rear end of said handrail and a distal end rotatably attached to said base, said proximal end of said leg and the rear end of said handrail being movably attached to said deck to allow said handrail to automatically collapse into a compact storage configuration when said deck is rotated from said operational position into said storage position by a combination of rotational movement and linear translation relative to said deck; and

35

(b) slider means, attached to the rear end of said handrail, for allowing linear translation of said handrail relative to said deck.

21. A treadmill as recited in Claim 19, wherein said base is capable of stably supporting the treadmill when said deck is in either said operational position or said storage position and when said deck is being repositioned therebetween.

22. A treadmill as recited in Claim 21, wherein said base comprises a body and a stabilizer member attached thereto.

23. A treadmill as recited in Claim 19, further comprising a pneumatic cylinder rotatably attached at one end thereof to said deck and at the opposite end thereof being rotatably attached to said base.

24. A treadmill as recited in Claim 19, wherein said handrail comprises:

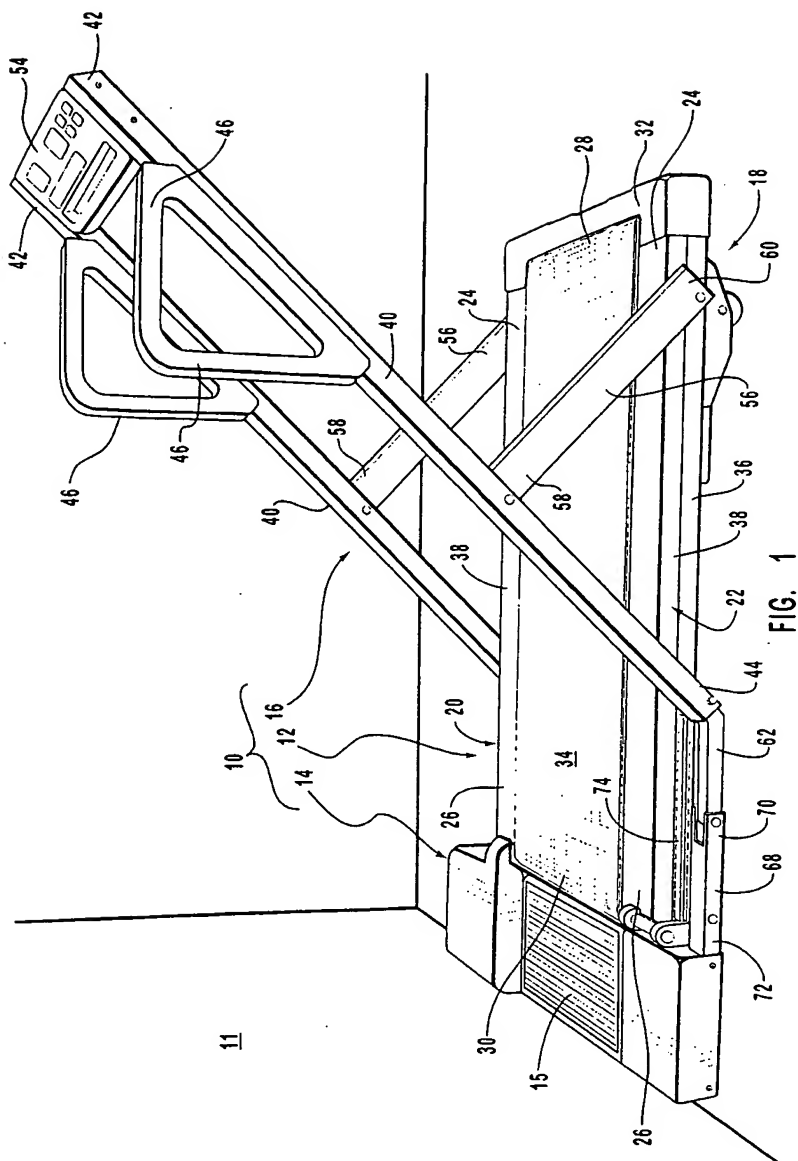
(a) a pair of uprights movably connected to said deck, said pair of uprights being configured to project above said deck when said deck is in said operational position and to automatically collapse into substantial alignment with said deck when said deck is rotated into said storage position; and

(b) a pair of handles attached to said uprights.

**STATEMENT UNDER ARTICLE 19**

Please amend the claims in the above-identified application by cancelling sheets 15-21 of this application which contain the claims and abstract. Please substitute therefore, sheets 15-21 attached hereto, which contain the new claims to be entered in this application. The abstract has not been amended and is found on substitute page 21.

The amendments submitted herein are intended to place this application into conformity with the amendments entered in the corresponding U.S. application. No new matter has been introduced by these amendments. Applicant believes that the amended claims submitted herewith more accurately and distinctly point out the inventive concepts Applicant wishes to claim.



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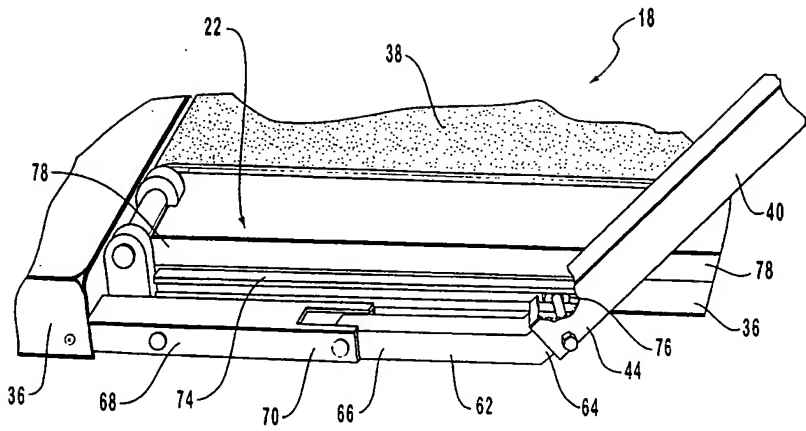


FIG. 2A

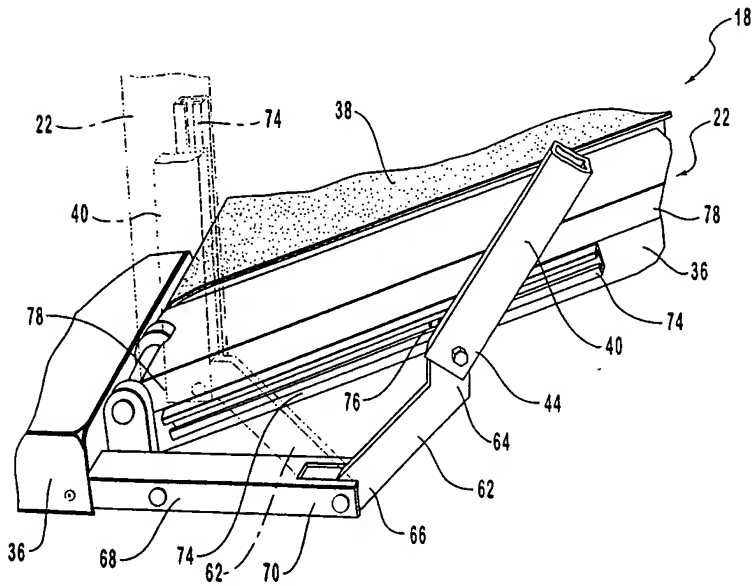
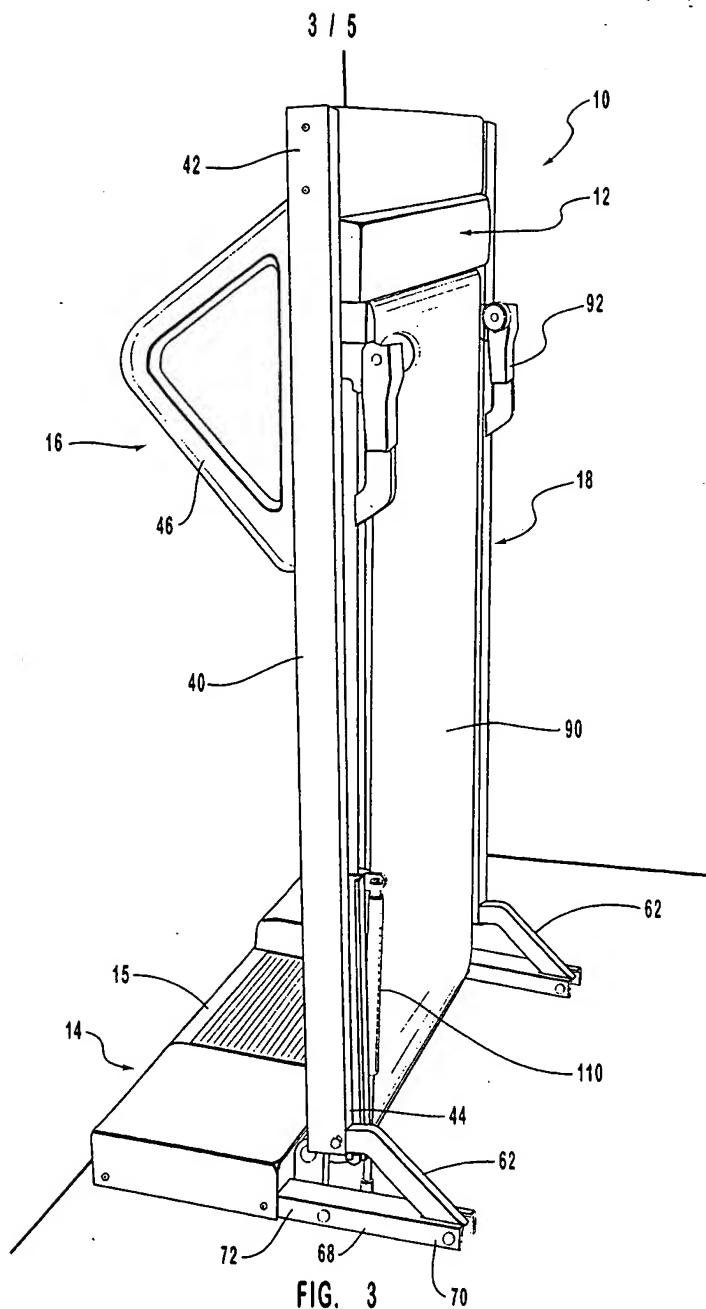


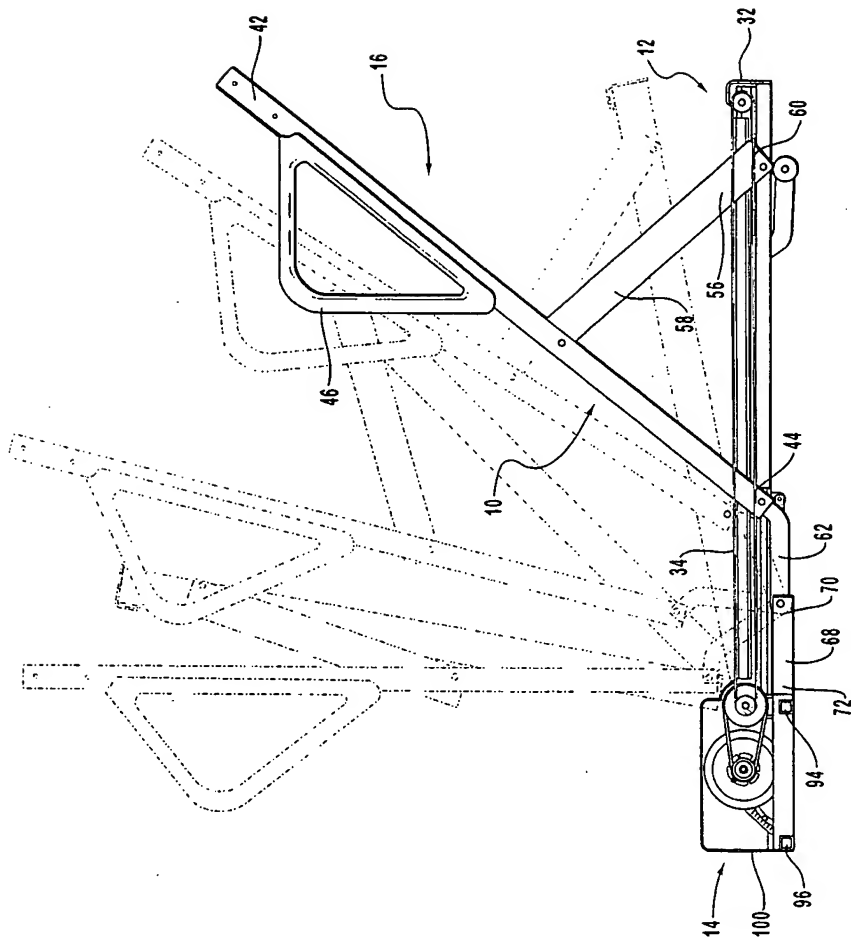
FIG. 2B





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FIG. 4



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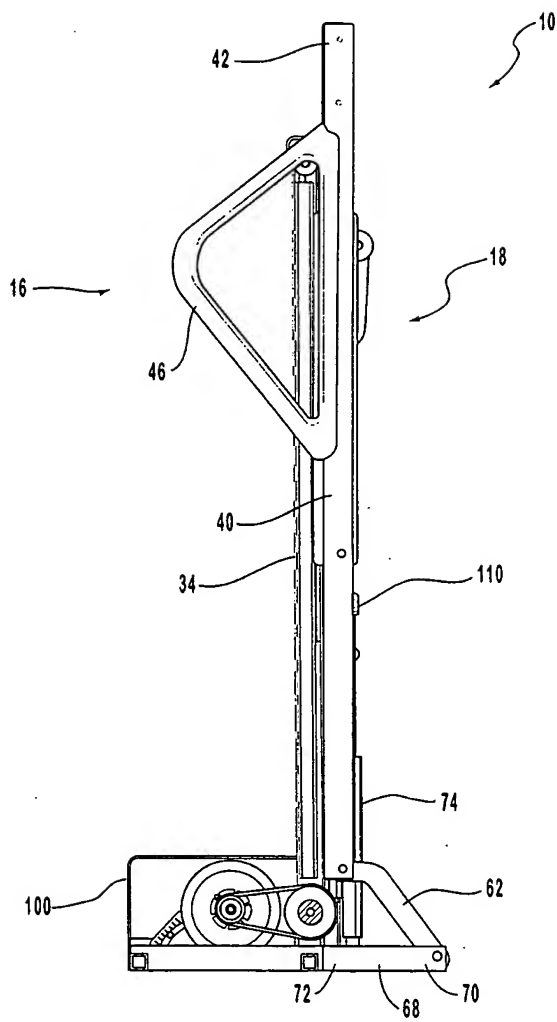


FIG. 5

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/18455

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A63B 22/02

US CL : 482/54

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 482/54

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 5,746,682 A (HUNG) 05 May 1998, entire document.	1-24
Y,P	US 5,733,228 A (STEVENS) 31 May 1998, entire document.	1-24
A	US 4,759,540 A (YU et al) 26 July 1988, entire document.	1-24

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

## \* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*B\* earlier document published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

\*A\* document member of the same patent family

Date of the actual completion of the international search

03 DECEMBER 1998

Date of mailing of the international search report

21 JAN 1999

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